Method for Carbon Nanotube Emitter Surface Treatment

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to a method for carbon nanotube emitter surface treatment, which is used to increase the number of CNT (carbon nanotube) exposed on device for advancing the current density and magnitude of CNT emitter.

2. Description of the Prior Art

To implement the possibility of displays planarization, the CNT-FED (carbon nanotube field emission) adopts the technology of screen-printing process and FED display in the prior art. It not only keep the image quality of CRT displayer, but also the advantage of power-saving and slim-volume, and with the characters of CNT including low-conducting electronic field required, high density of emission current, high stability, so it may offer a flat displayer with good luminous efficiency, and large-size screen with power-saving and low-cost.

Refer to FIG. 1, which is showing the luminous theory of the triode structure of carbon nanotube field emitter display (CNT-FED) in the prior art. That is a kind of regular structure, which is used to raise the electronic energy up, advance the luminous efficiency, and

diminish the control voltage. Wherein, the structure of CNT-FED luminous theory including the processing steps of fabricating a cathode plate 102 above a substrate 101, and further depositing the nano-scale carbon nanotube on the cathode plate 102, that is a electronic source 103. The cathode plate 102 connects with a gate 105 by a dielectric 104, a voltage generated from the gate 105 is used to pull the electronics out of the cathode plate 102. the current direction of the electronics from cathode plate 102 is as the directions of arrows on FIG. 1. Then, because of an anode plate 107 set on the triode structure, the electronics emit from cathode plate 102 and impact on fluorescent screen 106. Finally, it generates the red, green and blue light through a glass plate 108.

In the prior art, when manufacturing the CNT emitter, the CNT (Carbon Nano Tube) and the organic matters are mixed to produce the CNT paste to be coated on the substrate and performed with masking by using the screen printing technology so as to form a field emission electronics source. Therefore, the number of the CNTs exposed on the surface of the CNT layer is closely relative to the density of the field emission current. It will be the key point to affect the current density of the field emission display. However, the drawback of the prior art is the problem of the uniformity of the field emission electronics source.

In order to resolve the problem of the uniformity of the surface of the CNT layer of the CNT emitter in the prior art, the Samsung

Electronic Inc. provides the relative technology where the laser scanning method is used for evening the surface. In US patent No. 6,436,221, assigned to the Industrial Technology Research Institute (ITRI) based in Taiwan and titled with "Method of Improving Field Emission Efficiency for Fabricating Carbon Nanotube Field Emitters," the manufacturing process for improving the field emission efficiency of the CNT electronics source is provided.

The casting surface treatment of the present invention can process the CNT electronics source in the triode or any structure and improve the uniformity of surface of CNT on carbon nanotube field emitter display in any kind of structure, and then increase the number of the CNT exposed on device.

SUMMARY OF THE INVENTION

It is a primary object of the present invention to provide a method for carbon nanotube emitter surface treatment, which is used to increase the number of carbon nanotube exposed on the triode structure device. For advancing the current density and intensity of CNT emitter, the invention uses a method of casting surface treatment on the CNT emitter including the steps of coating an adhesive material on the surface of device; heating the adhesive material for adhibitting the surface; and lifting the adhesive material off.

BRIEF DESCRIPTION OF THE DRAWINGS

The objects, spirits and advantages of the preferred embodiments of the present invention will be readily understood by the accompanying drawings and detailed descriptions, wherein:

FIG. 1 is a schematic diagram showing the luminous theory of the triode structure of carbon nanotube field emitter display;

FIG. 2A is the 1st schematic diagram showing the method for carbon nanotube emitter surface treatment in accordance with the first preferred embodiment of the present invention;

FIG. 2B is the 2nd schematic diagram showing the method for carbon nanotube emitter surface treatment in accordance with the first preferred embodiment of the present invention;

FIG. 2C is the 3rd schematic diagram showing the method for carbon nanotube emitter surface treatment in accordance with the first preferred embodiment of the present invention;

FIG. 3A is the 1st schematic diagram showing the method for carbon nanotube emitter surface treatment in accordance with the second preferred embodiment of the present invention;

FIG. 3B is the 2nd schematic diagram showing the method for carbon nanotube emitter surface treatment in accordance with the second preferred embodiment of the present invention;

FIG. 3C is the 3rd schematic diagram showing the method for

carbon nanotube emitter surface treatment in accordance with the second preferred embodiment of the present invention;

FIG. 3D is the 4th schematic diagram showing the method for carbon nanotube emitter surface treatment in accordance with the second preferred embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

In the triode structure of carbon nanotube field emission display (CNT-FED), the invention adopts a method for casting surface treatment to increase the number of carbon nanotube exposed on the surface of the device. And the invention also can advance the current density and intensity of CNT emitter in gate hole formed around the CNT electronic source in the triode or any structure of CNT-FED, then the CNT emitter can emit the electronics in high-density and great-intensity uniformly.

The method of surface treatment comprises the steps below:

Please refer to FIG.2A to FIG.2C, which are schematic diagrams showing the method for carbon nanotube emitter surface treatment in accordance with the first preferred embodiment of the present invention. There is showing a triode structure of CNT-FED using the manufacturing process of semi-conductor thin film. First, refer to the FIG.2A, there is a two-dimension distribution cathode plate 203 fabricating on a glass substrate 201, and there is a dielectric

205 between the glass substrate 201 and a gate 207 of the triode CNT-FED. When there exists electric charges on the gate 207, some free electronics will be pull out from the cathode plate 203. Then these free electronics will move to the way to gate 207, and become a electronic channel. Furthermore, there are carbon nanotubes depositing above the cathode plate 203, and generating a greater current density, more powerful intensity CNT electronics source 209.

In FIG.2A, there is a dispenser 211, and coating an adhesive material 213 on the surface of the CNT-FED structure. The method of the invention doesn't limited by the area size to be coated, and the adhesive material 213 is not only sticky but impervious to the device, that could be a thermal adhesives or a soluble material. Refer to FIG.2B, that is showing a step of melt of adhesive material 213, as the adhesive material 213 is heated, then it will be soften and attached on the triode structure surface of CNT-FED closely and uniformly. After the process of coating the adhesive material 213 and melt to attach the surface of device, next, lifting the adhesive material 213 off from the surface of CNT-FED, especially from the surface of CNT electronic source 209 above that device as showed in FIG. 2C. For improving the luminosity and uniformly display of panel as the electronics impact the fluorescent screen on anode plate, the step of lifting material off can remove the impurity, which affects the electronics emission, from the surface of CNT, and increase the number of carbon nanotube exposed on the triode structure device.

The FIG.3A to FIG.3D are the schematic diagrams showing the method for carbon nanotube emitter surface treatment in accordance with the second preferred embodiment of the present invention. In these diagrams, there is cathode plate 303 fabricating on a substrate 301, and there is a dielectric layer 305 deposited between a cathode plate 303 and the gate 307 of the triode CNT-FED. Furthermore, there is a CNT layer 309 deposited carbon nanotube electronic source and is set between the cathode plate and the gates existed in said triode structure, wherein the CNT layer 309 mentioned above is the CNT electronics source 309.

In FIG.3A, which is showing the step of coating an activator 311 on the surface of the CNT-FED triode structure, the activator 311 could be an interface activator or any release agent , and the activator 311 is used to prevent too close sticky between the adhesive material 313 and dielectric layer 305 in the gate hole. Next, refer to FIG.3B, which is the step of coating an adhesive material 313 on the activator above the CNT-FED triode structure. The process showed on FIG.3C is a step of pressing the adhesive material 313 for adhibitting the device surface closely by a laminator, otherwise, the adhesive material 313 could be the thermal adhesives or a soluble material. Please refer to FIG.3D, which is the step of lifting the adhesive material 313 off from the triode surface of CNT-FED, i.e. lifting the impurity or any other adhesion, which will affect the electronics emission density and intensity of CNT electronics source 309, off

from the device surface .

A method for carbon nanotube emitter surface treatment, which is used on a carbon nanotube electronics source for increasing the number of carbon nanotube exposed on a triode or any structure of CNT-FED, then the method can advance the current density and intensity of CNT emitter, the method for carbon nanotube emitter surface treatment comprising the steps of:

According to the above discussion, the present invention discloses method for carbon nanotube emitter surface treatment, which adopts a method of casting surface treatment on the CNT emitter used to increase the number of carbon nanotube exposed on the triode structure device, and then advancing the current density and intensity of CNT emitter.

Although this invention has been disclosed and illustrated with reference to particular embodiments, the principles involved are susceptible for use in numerous other embodiments that will be apparent to persons skilled in the art. This invention is, therefore, to be limited only as indicated by the scope of the appended claims.